REMARKS

Applicant has made extensive amendments to the claims in attempting to meet the Examiner's rejections and objections. It is believed that these amendments place the case in condition for allowance. Should they not do so, however, applicant urgently requests that the examiner call his undersigned attorney, J. Philip Polster, at 314-238-2400, extension 426, to arrange an interview.

Specification

The specification has been amended at page 6 to provide proper antecedent basis for claim 31. It is noted that claim 31 was an original claim, and as such forms a part of the specification. Therefore, the amended paragraph, incorporating material from the claim and spelling out the inherent operation of a pinch roller and drive roller pair, is believed to provide the required antecedent basis for the claim.

Claim Rejections – 35 U.S.C. § 112

The foregoing amendment overcomes the Examiner's rejections of claims 27-32, 64, 65, 68, and 69 under 35 U.S.C. § 112. Applicant thanks the Examiner for reading the claims carefully and pointing out these problems with the claims.

Claim Rejections – 35 USC § 102

Claims 12 and 66 have been canceled without prejudice to applicant's right to reintroduce claims directed to their subject matter in a continuing application.

Claims 27-30 were rejected under 35 USC § 102(b) as anticipated by Dietzsch, U.S. Patent No. 4,078,909. This rejection is respectfully traversed.

Claim 27 has been extensively modified to recite "an adjustment device operatively attached to a part of the hollow inner forming tube outside the chamber, the adjustment device physically moving the portion of the forming tube in the vicinity of the outlet to affect at least one dimension of the tube." Nothing in Dietzsch corresponds to this limitation, and nothing in Dietzsch or any of the other art of record suggests such an adjustment device.

Claim 28 has been canceled without prejudice, and claims 29-30 are dependent on claim 27 and are believed to be allowable with it. They also add features which, in the combination claimed, are believed to be new and unobvious. Claim 30 has been rewritten to make its limitations relate to the claimed apparatus rather than to the material contained in it.

Claims 37 and 38 were rejected under 35 USC § 102(b) as anticipated by Bogdahn, U.S. Patent No. 6,098,428. Bogdahn is directed to a redraw process for forming glass tube or fiber. As noted in the present specification, such a process is highly dependent on the precision of the blank from which the draw is made. This process is entirely unlike the present process as set out in claim 37. Claim 37 has been amended to recite a "method of controlling the rate at which a solid rod of heat-softenable material is fed through a heated restriction into a melting chamber, the restriction contacting and softening at least an outer portion of the rod...." This is entirely different from the method of Bogdahn, in which the

temperature of a “drawing bulb” part of a glass blank, hanging in space, is measured. Nothing in Bogdahn or in any of the other art of record shows or suggests the method as now set out in claim 37.

Claim 38 is dependent on claim 37 and is believed to be allowable with it. This claim adds that “the melting chamber includes an outlet, the material forming a draw down at the outlet,” thereby underscoring that the drawdown measured by Bogdahn is an entirely different part of the method of the present invention from that set out in claim 37.

Claims 31 and 32 were rejected under 35 USC § 102(e) as anticipated by Schmitt, U.S. Patent No. 6,938,422. Schmitt, like Bogdahn, is directed to a redraw process in which a precisely formed blank is pulled and elongated to form a continuous tube. Schmitt uses a diameter sensor 13 to control the rate at which the continuous tube is drawn.

Claim 31 has been extensively rewritten to recite “a plurality of feed drives positioned and proportioned to feed said glass rod sections, at least two of the feed drives being biased into engagement with the rod sections, a sensor which detects rod section ends, and a mechanism which varies the bias of one of said at least two feed drives in response to the sensor while maintaining the bias of the other of said at least two feed drives to protect the rod section ends while continuing to feed the rod sections. Nothing in Schmitt operates in this manner. Should the blank run out, as suggested by the Examiner, the sensor 13 would presumably simply stop the drawing mechanism. It is therefore believed that

claim 31 as now written defines a structure neither shown nor suggested by Schmitt or any of the other art of record.

Claim 32 is dependent on claim 31 and is believed to be allowable with it. This claim has been amended to recite the functioning of the device, rather than merely the structure of the rods which it handles. It is noted that the dummy cylinder 10 appears to be merely a centering and pushing device for the precision blank 1.

Claim Rejections – 35 USC § 103

Claims 11 and 64 have been rejected under 35 USC 103(a) as being unpatentable over Dietzsch in view of Sasaki, U.S. Patent No. 5,540,746.

Dietzsch is a gravity-fed tube-making machine similar to applicant's own machine (U.S. Patent No. 3,401,028) described in the specification at page 1, lines 25 et seq., and is believed to have the same limitations as that design. Sasaki is an injection mold using a glass rod as a molding material. Because the "glass is filled in the forming mold immediately after melting" (col. 3, ll. 8-9) and because the heated nozzle is turned off and cooled to prevent "drooling" after the mold is filled, Sasaki is not concerned with any sort of continuous controlled movement of the glass rod, or with any sort of precision control of the glass extruded through his nozzle. Absent applicant's disclosure, no one skilled in the art would look to Sasaki for a solution to the problem of producing high-precision glass tubing without the use of a high-precision preform.

Claim 11 has now been rewritten for clarity and to add “a step of controlling the dimensions of the tube, said step of controlling the dimensions of the tube comprising controlling the rate at which the glass rod is pushed into the inlet by means of a feedback system.” Nothing in Dietzsch, Sasaki, or the other art of record, taken alone or in combination, shows or suggests the combination set out in claim 11.

Claim 64 adds that “the rod is substantially horizontal as it enters the heating chamber and the tube is substantially horizontal as it exits the heating chamber.” The Examiner’s position that “cross-sectional axes of the tube are in a horizontal plane immediately after exiting the chamber” and that at some point after exiting the tube is coiled, hence horizontal at two points, ignores the plain meaning of the claim. Dietzsch, of course, has no rod. Claim 64 is neither shown nor suggested by the prior art taken alone or in combination, and is also allowable because it is dependent on claim 11.

Claims 14 and 15 have been amended to be dependent on claim 11 and are believed to be allowable with it. Sasaki simply pushes the melted tip of the rod into the injection mold until it is filled, and thus does not have any need or occasion to care about variations in the size of the rod or the size of the inlet to his heating cylinder. Sasaki therefore teaches nothing about variations in rod size or the relative size of the inlet, as set out in these claims. Applicant’s process for forming high-precision tubing, however, accommodates these variations in ways not suggested by the prior art, taken alone or in combination.

Claims 65 and 67-69 were rejected under 35 USC 103(a) as being unpatentable over Dietzsch and Sasaki (as applied against claims 11 and 64 supra) in view of Senapati U.S. Patent No. 6,128,926. Senapati teaches a heating chamber (furnace 14) having an inlet (open top) and an outlet (die 16). When the piston 18 is removed, a solid glass preform 13 may be placed in the chamber 14. The preform 13 is formed by core drilling a fully dense preform (col. 4, lines 39-43). This preform is melted in the chamber 14 and is pushed by a piston 18 through the die 16 to form a rod (not a tube). The rod, after centerless grinding, may achieve diameter and roundness tolerances of ± 1μm (1,000 nanometers). (Col. 5, lines 41-43.)

Claims 65 and 67 are dependent on claim 11 and are believed to be allowable with it. In addition, claim 65 as now written recites that "the rod is pushed into the inlet at a controlled speed, the method further comprising a step of determining changes in the diameter of the rod, and a step of controlling the speed of feeding the rod in response to changes in the diameter of the rod." Senapati appears to melt the entire preform in the chamber 14; therefore, there are no changes in the diameter of a rod to compensate for.

Claim 68 is directed to a method of continuously making a glass tube free of airlines in the tube wall. This is a long-sought result, and applicant's method is believed to be the first to achieve it. Dietzsch relies on gravity to feed his melted glass and is thus, as a practical matter, incapable of achieving the pressures needed to make the resulting tube free of airlines in the tube wall. As discussed

above, Dietzsch also fails to disclose a step of pushing a horizontal solid glass rod into the inlet of a heating chamber or a step of pulling a horizontal tube from the outlet of a heating chamber. Neither does Dietzsch teach or suggest an inlet to a heating chamber comprising a heated cone having a diameter less than the diameter of a solid glass rod, the cone melting the exterior of the rod and forming a molten glass seal at the inlet. As discussed above, Sasaki would not have suggested to one skilled in the art any way of modifying Dietzsch to overcome the problem of air lines in the walls of precision tubing. Senapati is directed to forming rods and utilizes an entirely different batch process approach to feeding glass into his system. None of the art, taken alone or together, suggests the method as set out in claim 68 or its dependent claim 69.

New claim 70 is directed to a method of making a high precision glass tube having tolerances for outside diameter, inside diameter, roundness, wall thickness and axial center of inside diameter in relation to the outside diameter of less than one hundred nanometers. This degree of precision, made possible by the present invention as set out in the remainder of the claim, is unprecedented. As previously noted, Senapati achieves a precision an order of magnitude less (1000 nm) for merely the outside diameter and roundness of a rod, and achieves that degree of precision only by centerless grinding the rod after it has been drawn.

As set out in claim 70, the method comprises a step of providing a heating chamber, the heating chamber having a single inlet, a single outlet, and a hollow

inner forming tube extending from the vicinity of the outlet, within an inside dimension of the outlet, through a gland in a wall of the chamber, a step of pushing a solid glass rod substantially horizontally into the inlet at a controlled speed, the inlet comprising a heated cone having a diameter less than the diameter of the solid glass rod, the cone melting the exterior of the rod and forming a molten glass seal at the inlet, and a step of pulling a tube from the outlet substantially horizontally at a controlled speed.

Claims 71-75 are dependent on claim 70 and are believed to be allowable with it. They also add features which in the claimed combination are believed to be novel and unobvious.

It is believed that the claims currently being presented are patentable over the prior art. It is respectfully requested that the case be passed to issue. Should the Examiner not believe the claims are now in condition for allowance, applicant requests a telephone call to his undersigned attorney (314-238-2400, extension 426) to arrange a personal interview with the Examiner and the Examiner's SPE.

Respectfully submitted,

/JPhilipPolster/

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